# AUTOMATA
# SET- 9

## SOLUTIONS

**1.** Let L = {ab, aa, baa}

Which of the following are not in L* ?

(a) abaabaaaa
(b) aaaabaaaa
(c) baaaaabaa
(d) baaaabaaababa

**Solution:** Option (d)

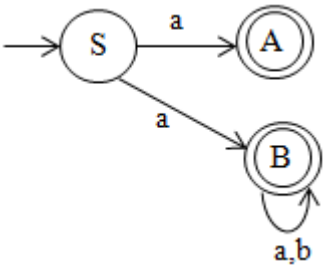
**2.** Let M be a Non-deterministic Finite Machine. Let G be the Regular Grammar obtained from M.

Which is True?

(a) G will always be unambiguous
(b) G will always be ambiguous
(c) G may be ambiguous
(d) None of the above

**Solution:** Option (c)

**Explanation:**




G will be ambiguous.

**3.** Consider this grammar:

$$S \rightarrow SS \mid a$$

How many derivation trees are possible for $a^4$?

(a) 3
(b) 4
(c) 5
(d) 6

**Solution:** Option (c)

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**4.** Consider the Language:

$L = \{a^n b^n c^k, n,k \geq 1\} \cup \{a^n b^k c^k, n,k \geq 1\}$

Which is True?

(a) All the Grammars generating L will be ambiguous.
(b) There exists a G which is unambiguous.
(c) Language L is unambiguous
(d) None of the above

**Solution:** Option (a)

**Explanation:**
L is inherently ambiguous.

G will be of type:

$S \rightarrow S_1 \mid S_2$

abc abc

Common string abc will be derived either using $S_1$ or $S_2$.

**5.** Consider these 2 sets:

$$\rho = (1^*0 + 001)^* 01$$
$$\varphi = (1^*001 + 00101)^+$$

(a) Both are equivalent
(b) Both are not equivalent
(c) $\varphi \supseteq \rho$
(d) None of the above

**Solution:** Option (b)

**Explanation:**
$\rho$ has minimum string 01 not present in $\varphi$.

**6.** Let R be Regular set. Let S be set consisting of all strings in R which are identical with their own reverses. What can you say about S?

(a) S is regular
(b) S is non-regular
(c) S may or may not be regular
(d) None of the above

**Solution:** Option (c)

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**Explanation:**
Case 1: Let the regular set R be 0* and S be 0* which is regular.
Case 2: Let the regular set R be 0*10* and S be a subset of R such that the strings are identical with their own reverses.
$S = \{0^n10^n \mid n \geq 0\}$ which is CFL but not Regular.

**7.** Suppose L is a context-free language over $\Sigma = \{a\}$ i.e. only one alphabet. What can you say about L?

(a) L is always regular
(b) L need not be regular
(c) L is always DCFL
(d) L is always NCFL

**Solution:** Option (a)

**Explanation:**
The language $\Sigma = \{a\}$ is regular. And every Regular is a CFL. Given L is CFL which implies L is regular. So, CFL over one alphabet will always be regular.

**8.** Minimum number of states in DFA over $\Sigma = \{0, 1\}$ with each string contains odd number of 0's or odd number of 1's.

(a) 3
(b) 4
(c) 5
(d) 6

**Solution:** Option (b)

**9.** Let L be a Context Free Language. Even(L) is the set of all strings w in L such that |w| is even.

What can you say about Even(L)?

(a) It will be regular
(b) It will be context-free
(c) It is not decidable
(d) None of the above

**Solution:** Option (b)

**Explanation:**
Given that L is a CFL, we cannot decide whether L is a regular or not without knowing the language itself. And Even(L) is a subset of L such that length of each string in Even(L) is even. Thus, Even(L) is definitely a CFL but cannot decide upon regularity.

i.e., Even(L) is the intersection of L with the DFA that accepts even length strings

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i.e. Even (L) = CFL ⋂ Regular
= CFL
So, Even (L) is a closed operation.

**10.** Consider this grammar:

$$S \rightarrow bF,\ S \rightarrow aS,\ F \rightarrow \varepsilon\ ,\ F \rightarrow bF \mid aF$$

Regular Expression for this grammar is?

(a) (a + b)* b (a + b)*
(b) a*b(a + b)*
(c) (a + b)* ba*
(d) All of the above

**Solution:** Option (d)

**Explanation:**
All regular expression represents the language containing at least 1 b.

**11.** Let L be a regular language. Consider L' = {xy: x∈L and y ∉ L}

L' is

(a) Always regular
(b) Need not be regular
(c) Context-free
(d) Depends on L

**Solution:** Option (a)

**Explanation:**
L' is concatenation of 2 regular languages basically L and $\bar{L}$. Regular are closed under concatenation.

**12.** Consider two statements:

$S_1$: Every regular language has regular proper subset.
$S_2$: If $L_1$ and $L_2$ are non-regular, then $L_1 \cup L_2$ is also not-regular.

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow$ True, $S_2 \rightarrow$ False
(d) $S_1 \rightarrow$ False, $S_2 \rightarrow$ True

**Solution**: Option (b)

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**Explanation:**
$S_1 \rightarrow L = \{\varphi\}$
$S_2 \rightarrow \{a^n b^m \mid n \leq m\} \cup \{a^n b^m \mid n \geq m\}$

**13.** $L_1 = \{a^m b^n c^{max(m,n)} : m,n > 1\}$
$L_2 = \{a^{2^n}, n > 1\} \cup \{a^m, m>1\}$

(a) Both are regular
(b) Only $L_2$ is regular
(c) Only $L_1$ is regular
(d) None of the above

**Solution**: Option (b)

**Explanation:**
$L_1$ is not regular as the language is either $\{a^m b^n c^m : m,n > 1\}$ if m > n or $\{a^m b^n c^n : m,n > 1\}$ if n > m, in which case both are context free but not regular.

$L_2 \rightarrow a^*$

**14**. Consider this Context-Free Grammar:

$$S \rightarrow aSa \mid bSb \mid aSb \mid bSa \mid \varepsilon$$

(a) L(G) is regular
(b) L(G) is DCFL
(c) L(G) is NCFL
(d) L(G) is ambiguous

**Solution**: Option (a)

**Explanation:**
G is producing all even length strings which is a regular language.

**15.** Consider this FSM 'M' :

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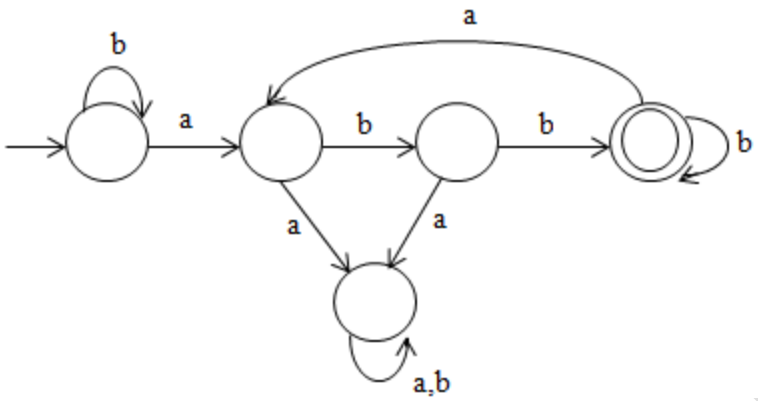


Language is

(a) {w ∈ (a+b)* | every a in w is followed by exactly 2 b's}
(b) {w ∈ (a+b)* | every a in w is followed by at least 2 b's}
(c) {w ∈ (a+b)* | w has substring abb}
(d) {w ∈ (a+b)* | w does not contain 'aa' as substring}

**Solution:** Option (b)

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